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U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

ATTORNEY'S DOCKET NUMBER

TRANSMITTAL LETTER TO THE UNITED STATES
DESIGNATED/ELECTED OFFICE (DO/EO/US)
CONCERNING A FILING UNDER 35 U.S.C. 371

13027.16USWO

U.S. APPLICATION NO (If known, see 37 CFR 1.5)

unknown 09/913015

INTERNATIONAL APPLICATION NO.

PCT/EP00/01034

INTERNATIONAL FILING DATE

9 February 2000

PRIORITY DATE CLAIMED

12 February 1999

TITLE OF INVENTION

DISTRIBUTION BOX

APPLICANT(S) FOR DO/EO/US

ROTH-STIELOW et al.

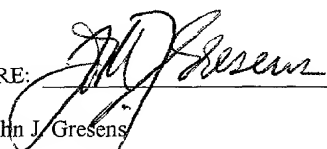
Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(I).
4. ☒ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
 - a. ☒ is transmitted herewith (required only if not transmitted by the International Bureau).
 - b. ☒ has been transmitted by the International Bureau.
 - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US)
6. ☒ A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
 - a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
 - b. ☐ have been transmitted by the International Bureau.
 - c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
 - d. ☒ have not been made and will not be made.
8. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)).
10. ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11. to 16. below concern document(s) or information included:

11. ☒ An Information Disclosure Statement under 37 CFR 1.97, Form 1449, 5 references
12. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☒ A **FIRST** preliminary amendment.
☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
14. ☒ A substitute specification.
15. ☐ A change of power of attorney and/or address letter.
16. ☒ Other items or information: Preliminary Amendment, Marked-up Copy, Abstract, International Publication Page, Courtesy Copy of PCT/EP00/01034 in German, Form PCT/ISA/210, 6 Sheets of Formal Drawings

518 Rec'd PCT/PTO 3 8 AUG 2001

U.S. APPLICATION NO. (If known, see 37 C.F.R. 1.5) unknown 09/913015		INTERNATIONAL APPLICATION NO. PCT/EP00/01034		ATTORNEY'S DOCKET NUMBER 13027.16USWO	
17. [X] The following fees are submitted:				CALCULATIONS PTO USE ONLY	
BASIC NATIONAL FEE (37 CFR 1.492(a) (1)-(5)): Search Report has been prepared by the EPO or JPO.....\$860.00 International preliminary examination fee paid to USPTO (37 CFR 1.492(a)(1)).....\$690.00 No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2)).....\$710.00 Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(3)) paid to USPTO \$1000.00 International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4)\$100.00					
ENTER APPROPRIATE BASIC FEE AMOUNT =				\$860.00	
Surcharge of \$130.00 for furnishing the oath or declaration later than [] 20 [] 30 months from the earliest claimed priority date (37 CFR 1.492(e)).				\$	
CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	23 -20 = 3		X \$18.00	\$54.00	
Independent claims	3 -3 = 0		X \$80.00	\$0.00	
MULTIPLE DEPENDENT CLAIM(S) (if applicable)			+ \$260.00	\$	
TOTAL OF ABOVE CALCULATIONS =				\$914.00	
Reduction by 1/2 for filing by small entity, if applicable. Small entity status is claimed pursuant to 37 CFR 1.27				\$	
SUBTOTAL =				\$914.00	
Processing fee of \$130.00 for furnishing the English translation later than [] 20 [] 30 months from the earliest claimed priority date (37 CFR 1.492(f)).				+ \$	
TOTAL NATIONAL FEE =				\$914.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). \$40.00 per property				+ \$	
TOTAL FEES ENCLOSED =				\$914.00	
				Amount to be:	
				refunded	\$
				charged	\$
a. [X] Check(s) in the amount of \$914.00 to cover the above fees is enclosed. b. [] Please charge my Deposit Account No. _____ in the amount of \$ _____ to cover the above fees. A duplicate copy of this sheet is enclosed. c. [X] The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 13-2725.					
NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.					
SEND ALL CORRESPONDENCE TO John J. Gresens MERCHANT & GOULD P.O. Box 2903 Minneapolis, MN 55402-0903					
SIGNATURE:  NAME: John J. Gresens REGISTRATION NUMBER: 33,112					

S/N unknown

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: ROTH-STIELOW et al. Serial No.: unknown
Filed: concurrent herewith Docket No.: 13027.16USWO
Title: DISTRIBUTION BOX

CERTIFICATE UNDER 37 CFR 1.10

'Express Mail' mailing label number: EL669942019US

Date of Deposit: 8 August 2001

I hereby certify that this correspondence is being deposited with the United States Postal Service 'Express Mail Post Office To Addressee' service under 37 CFR 1.10 on the date indicated above and is addressed to the Assistant Commissioner for Patents, Washington, D.C. 20231.

By: 

Name: Omesh Singh

PRELIMINARY AMENDMENT

Box PCT
Assistant Commissioner for Patents
Washington, D. C. 20231

Dear Sir:

In connection with the above-identified application filed herewith, please enter the following preliminary amendment:

IN THE ABSTRACT

Insert the attached Abstract page into the application as the last page thereof.

IN THE SPECIFICATION

Enclosed is a substitute specification.

IN THE CLAIMS

Please amend claims 4-11, 13-18, and 21 as follows:

4. (Amended) Distributor box according to Claim 1, wherein a first upper housing compartment comprises an electronic circuit that is electrically connected at least to the field bus and the system bus.

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5. (Amended) Distributor box according to Claim 1, wherein a second upper housing compartment defines a closed spatial region.
6. (Amended) Distributor box according to Claim 1, wherein a third upper housing compartment comprises an electronic circuit that can be electrically connected to at least the system bus and brake leads.
7. (Amended) Distributor box according to Claim 1, wherein the lower housing compartment comprises a braking resistance of a converter and the braking resistance is connected to the electronic circuit of the third upper housing compartment.
8. (Amended) Distributor box according to Claim 1, wherein the transfer pin-and-socket connector in each case constitutes the only electrical connection between the cabling in the lower housing compartment and the electronic circuit in the associated upper housing compartment.
9. (Amended) Distributor box according to Claim 1, wherein the transfer pin-and-socket connector device in each case and a ground-connection cable constitute the only electrical connection between the cabling in the lower housing compartment and the electronic circuit in the associated upper housing compartment.
10. (Amended) Distributor box according to Claim 1, wherein the set of field-bus leads and/or control-bus leads also includes leads for supply voltages.
11. (Amended) Distributor box according to Claim 1, wherein the lower housing compartment comprises a motor-protection switch, in particular for the electrical disconnection of high tension leads.

13. (Amended) Distributor box according to Claim 1, wherein the electronic circuit is designed so as to be addressable as a bus participant and can filter out from the field bus data that are destined for this address and translate them into a control-bus protocol and send the result by way of the control bus to the field mechanism or mechanisms supplied from the distributor box.
14. (Amended) Distributor box according to Claim 1, wherein the electronic circuit comprises settable switches, such as DIP switches or the like, with which to set the field-bus address.
15. (Amended) Distributor box according to Claim 1, wherein at least one upper housing compartment comprises connector devices for the connection of external sensors and/or actuators.
16. (Amended) Distributor box according to Claim 1, wherein at least one upper housing compartment comprises a connector device for a control unit, in particular a computing device such as a PC or the like, in particular for balancing SPS programs, control programs, data or the like and/or devices for outputting and/or displaying data such as the states of sensors, actuators or drive mechanisms.
17. (Amended) Distributor box according to Claim 1, wherein at least one upper housing compartment comprises display devices such as LEDs and/or LCD displays or the like.
18. (Amended) Distributor box according to Claim 1, wherein at least one upper housing compartment comprises control elements such as keys, push-buttons, rotating knobs or the like for input and/or for controlling processes.
21. (Amended) Distributor box according to Claim 19, wherein the housing is constructed at least in part for giving off heat, in particular comprises cooling fingers and/or cooling ribs.

REMARKS

The above preliminary amendment is made to remove multiple dependencies from claims 4-11, 13-18, and 21.

Attached hereto is a marked-up version of the changes made to the claims by the current amendment. The attached page is captioned "Marked-up Copy".

A new abstract page is supplied to conform to that appearing on the publication page of the WIPO application, but the new Abstract is typed on a separate page as required by U.S. practice.

Applicants respectfully request that the preliminary amendment described herein be entered into the record prior to calculation of the filing fee and prior to examination and consideration of the above-identified application.

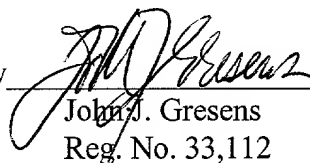
If a telephone conference would be helpful in resolving any issues concerning this communication, please contact Applicants' primary attorney-of record, John J. Gresens (Reg. No. 33,112), at (612) 371.5265.

Respectfully submitted,

MERCHANT & GOULD P.C.
P.O. Box 2903
Minneapolis, Minnesota 55402-0903
(612) 332-5300

Dated: 8 August 2001

By


John J. Gresens
Reg. No. 33,112

JJGresens:hjh

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4. Distributor box according to [one of the preceding claims,] claim 1, characterized in that a first upper housing compartment (51) comprises an electronic circuit that is electrically connected at least to the field bus and the system bus.
5. Distributor box according to [one of the preceding claims,] claim 1, characterized in that a second upper housing compartment (52) defines a closed spatial region.
6. Distributor box according to [one of the preceding claims,] claim 1, characterized in that a third upper housing compartment (53) comprises an electronic circuit that can be electrically connected to at least the system bus and brake leads.
7. Distributor box according to [one of the preceding claims,] claim 1, characterized in that the lower housing compartment (2) comprises a braking resistance of a converter (45) and the braking resistance is connected to the electronic circuit of the third upper housing compartment (53).
8. Distributor box according to [one of the preceding claims,] claim 1, characterized in that the transfer pin-and-socket connector in each case constitutes the only electrical connection between the cabling in the lower housing compartment (2) and the electronic circuit in the associated upper housing compartment (1, 51, 52, 53).

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9. Distributor box according to [one of the claims 1 to 7,] claim 1, characterized in that the transfer pin-and-socket connector device in each case and a ground-connection cable constitute the only electrical connection between the cabling in the lower housing compartment (2) and the electronic circuit in the associated upper housing compartment (1, 51, 52, 53).
10. Distributor box according to [one of the preceding claims,] claim 1, characterized in that the set of field-bus leads and/or control-bus leads also includes leads for supply voltages.
11. Distributor box according to [one of the preceding claims,] claim 1, characterized in that the lower housing compartment (2) comprises a motor-protection switch (31, 54), in particular for the electrical disconnection of high tension leads.
13. Distributor box according to [one of the preceding claims,] claim 1, characterized in that the electronic circuit is designed so as to be addressable as a bus participant and can filter out from the field bus data that are destined for this address and translate them into a control-bus protocol and send the result by way of the control bus to the field mechanism or mechanisms supplied from the distributor box.
14. Distributor box according to [one of the preceding claims,] claim 1, characterized in that the electronic circuit comprises settable switches, such as DIP switches or the like, with which to set the field-bus address.
15. Distributor box according to [one of the preceding claims,] claim 1, characterized in that at least one upper housing compartment (1, 51, 52, 53) comprises connector devices for the connection of external sensors and/or actuators.

16. Distributor box according to [one of the preceding claims,] claim 1, characterized in that at least one upper housing compartment (1, 51, 52, 53) comprises a connector device for a control unit, in particular a computing device such as a PC or the like, in particular for balancing SPS programs, control programs, data or the like and/or devices for outputting and/or displaying data such as the states of sensors, actuators or drive mechanisms.
17. Distributor box according to [one of the preceding claims,] claim 1, characterized in that at least one upper housing compartment (1, 51, 52, 53) comprises display devices such as LEDs and/or LCD displays or the like.
18. Distributor box according to [one of the preceding claims,] claim 1, characterized in that at least one upper housing compartment (1, 51, 52, 53) comprises control elements such as keys, push-buttons, rotating knobs or the like for input and/or for controlling processes.
21. Distributor box according to [at least one of the claims 19 to 20,] claim 19, characterized in that the housing is constructed at least in part for giving off heat, in particular comprises cooling fingers and/or cooling ribs (60).

ABSTRACT

A distributor box is provided for microprocessor, memory and logic components and/or power semiconductor components, with a housing comprising a lower housing compartment and at least one upper housing compartment, which can be connected to the lower compartment in a tightly sealed, firm manner to provide a high degree of protection. At least one transfer pin-and-socket connector is provided comprising a first and a second connector part, the first connector part of which is fixedly mounted in an upper housing compartment in such a way that when this upper compartment is set onto the lower compartment, the first connector part is brought into electrical contact with a second connector part of the transfer pin-and-socket connector, which fits together with the first part and is fixedly mounted in the lower housing compartment. In the lower housing compartment are mounted connecting devices or external terminal arrangements such as terminal strips or the like, so that a set of cables can be connected to at least the associated second pin-and-socket connector part. The lower housing compartment comprises a T-shaped, high tension cabling between two external connecting devices and one external terminal arrangement for a hybrid cable on the lower housing compartment. The lower housing compartment also comprises a T-shaped cabling for a field bus between two external terminal arrangements on the lower housing compartment and at least one second pin-and-socket connector part. In at least one upper housing compartment there is mounted an electronic circuit that can be electrically connected to a control bus by way of a first and a second pin-and-socket connector part. The lower housing compartment also comprises an external means of connecting a hybrid cable with hybrid pin-and-socket connector part that incorporates high tension and low tension leads, the high tension leads being connectable to at least one electronic circuit in an upper housing compartment.

A DISTRIBUTOR BOX

Field of the Invention

5 The invention relates to a distributor box.

Description of the Prior Art

10 In industrial plants many widely scattered items of
field equipment, in particular drive mechanisms, consisting
of electric motors with frequency or voltage converters or
switching devices, must be controllable from a central
computer. For this purpose various types of field buses are
used, such as the Interbus, Profibus, CANbus or the like. The
15 field equipment is provided with leads suitable for a field
bus and usually each mechanism includes an addressable
electronic control unit that filters data out of the field-
bus signals when those data are addressed to the particular
mechanism concerned.

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Energy or power is supplied to the field equipment by
way of high tension cables, in particular those designed for
three-phase current.

25 In many cases the manufacturers of field equipment make
use of other control-bus protocols, which are not in the same
category as field buses. For example, those skilled in the
art will be familiar with the control-bus protocol MOVILINK,
made by the firm SEW-EURODRIVE GmbH & Co. These control-bus
30 protocols are not compatible with the field-bus protocols
conventionally used in industry and are also termed system-
bus protocols. They can exhibit an extremely high data-
transfer rate. In particular, with such control or system
buses the commands and codings are designed specifically for
35 a certain group of devices, and in particular depend on the

individual manufacturer. On the whole, with system buses the real-time performance of applications can be improved.

5 The set of cables used for high voltage and bus systems is elaborate and expensive, in particular because of the stellate cable arrangement of the high tension wiring. One substantial cost factor is the time needed to install the cabling.

10 DE 40 05 086 discloses a terminal unit for domestic technology. The housing of this unit provides a separation between electronic circuitry and cabling. Here the cabling is mounted in the lower part of the unit and the electronic circuitry, in the upper part of the unit. This terminal unit
15 cannot be used for industrial plants.

The objective of the invention is to provide a distributor box which avoids the above-mentioned disadvantages. In particular, it is intended to enable
20 simple and inexpensive cabling.

Summary of the Invention

25 Essential features of this solution of the problem are that the distributor box with at least one electronic circuit, in particular comprising microprocessor, memory and logic components and/or power semiconductor components, with a housing, comprises

a lower housing compartment,
30 at least one upper housing compartment, which can be connected to the lower compartment in a tightly sealed, firm manner to provide a high degree of protection,

at least one transfer pin-and-socket connector, each of which comprises a first and a second connector part, the
35 first connector part of which is fixedly mounted in an upper housing compartment in such a way that when this upper

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compartment is set onto the lower compartment, the first connector part is brought into electrical contact with a second connector part of the transfer pin-and-socket connector, which fits together with the first part and is
5 fixedly mounted in the lower housing compartment,

wherein in the lower housing compartment are mounted connecting devices or external terminal arrangements such as terminal strips or the like, so that a set of cables can be connected to at least the associated second pin-and-socket
10 connector part,

and wherein the lower housing compartment comprises a T-shaped, high tension cabling, such as for a three-phase current, between two external connecting devices and one external terminal arrangement for a hybrid cable on the lower
15 housing compartment,

and wherein the lower housing compartment comprises a T-shaped cabling for a field bus between two external terminal arrangements on the lower housing compartment and at least one second pin-and-socket connector part,

and wherein in at least one upper housing compartment there is mounted an electronic circuit that can be electrically connected to a control bus by way of a first and a second pin-and-socket connector part,

and wherein the lower housing compartment comprises an external means of connecting a hybrid cable with hybrid pin-and-socket connector part that incorporates high tension and low tension leads,

and wherein the high tension leads of the hybrid cable can be connected to at least one electronic circuit in an
30 upper housing compartment.

Hence it advantageously enables the cabling arrangement to be very simple and inexpensive. In particular, parts can be preassembled and prefabricated, and thus need not be
35 handled individually during installation in the plant. The transfer pin-and-socket connector and connector parts enable

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a particularly rapid, secure and simple connection of housing compartments. In particular, the use of hybrid pin-and-socket connector parts also makes it possible to close and disconnect high tension and low tension leads in a time-
5 saving manner. The provision of the hybrid cable saves time and furthermore makes the layout of the whole cabling system clearer, because high tension and low tension cables no longer need to be positioned individually.

10 An especially crucial characteristic of the invention is that the leads of the field bus are looped through and therefore advantageously make possible annular structures of the cabling for field buses. A similar essential
15 characteristic of the invention is that the high tension cabling is T-shaped and the branch to the associated field mechanism is enabled by a hybrid cable. Hence it is possible to use annular cabling for the high voltage as well. Here it is of advantage that such cablings can be implemented in a distinctly more economical way, with a saving of materials.

20 The term "field mechanism" is understood here to include an electric motor with converter, an electric motor with a simple switching device to turn it on and off, an electric motor with smooth-starting device or the like.

25 The term "looped through" indicates that a cable coming from the exterior is connected by leads to an external terminal arrangement in the distributor box and then, by way of internal cabling, is connected to an additional external
30 terminal arrangement in the distributor box to which, in turn, a cable coming from the exterior is connected by leads.

The term "T-shaped cabling" should be understood to mean that a cable coming from the exterior is connected by leads
35 to an external terminal arrangement in the distributor box and then, by way of an internal cabling, is electrically

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connected to at least two additional external terminal
arrangements in the distributor box, to which in turn cables
coming from the exterior can be connected by leads. One of
these external terminal arrangements is designed for a hybrid
5 cable that comprises high tension and control-bus leads.

Another particularly essential characteristic of the
invention consists in the fact that cable systems and
connectors are fixedly mounted in the lower housing
10 compartment, so as to be immune to interference, whereas the
electronic apparatus that requires maintenance or repair, or
needs to be adjusted or replaced to suit the local
conditions, is disposed in the upper housing compartment.
This separation makes it possible to carry out extremely
15 complicated maintenance work even under adverse field
conditions, by merely exchanging one upper housing
compartment for another one with electronics that are
undamaged or suited to the altered conditions or
requirements. An added benefit is that the degree of
20 protection can be of a high standard, which is likewise
facilitated in particular by the mechanical and electrical
separation between the upper and lower compartments.

Altogether, then, the distributor box comprises at least
25 one electronic circuit, in particular one with
microprocessor, memory and logic circuitry, and a housing
with a lower compartment and at least one upper compartment,
which can be connected thereto in a tightly sealed and stable
manner and includes a transfer pin-and-socket connector, the
30 first part of which is fixedly mounted on the upper housing
compartment in such a way that when an upper housing
compartment is put into place on the lower housing
compartment, it is brought into electrical contact with a
second connector part of the transfer pin-and-socket
35 connector that is fixedly mounted in the lower housing
compartment. In this arrangement, external terminal

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arrangements such as terminal strips or the like are disposed in the lower housing compartment, in order to connect a cable arrangement to the second pin-and-socket connector part, and in the upper housing compartment the electronic circuitry is
5 disposed.

The low tension leads comprise, on one hand, preferably braking leads to control an electric motor with brake, in which case the braking leads can be connected to the
10 particular electronic circuitry that comprises a converter and can be connected to at least control-bus leads; on the other hand, they comprise control-bus leads, in which case the control-bus leads of the hybrid cable can be connected to the control-bus leads of the particular electronic circuitry
15 that is electrically connected to the field bus. It is advantageous here that in both cases the same type of hybrid cable can be used, so that there is a net reduction of expenditure.

20 Preferably the transfer pin-and-socket connector provides the only electrical connection between the cabling in the lower housing compartment and the electronic circuitry in each upper compartment. Therefore the electronics can be repaired or exchanged by simply exchanging one upper housing
25 compartment for another, with minimal manipulation, as the upper housing compartments with incorporated electronics have been constructed or reconstructed in suitable surroundings, i.e. not in the field.

30 In another preferable embodiment, the distributor box comprises a ground-connection cable between each upper housing compartment and the lower compartment. Hence the transfer pin-and-socket connectors and the ground-connection cable constitute the only electrical connection between the
35 upper and lower housing compartments. It is advantageous here

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that the upper housing compartment is grounded even after it has been opened or lifted off.

The field-bus leads, as low tension leads, in an advantageous embodiment also comprise leads for power supply, such as 24-V leads or the like. Shielding and grounding leads can also be included. It is advantageous here that the field-bus leads with power-supply leads are distinguished from the high tension cabling systems and can be cabled together with the field-bus leads.

In a further development the lower housing compartment comprises a motor-protection switch. It is advantageous here that for purposes of assembly, repair or installation it is possible to interrupt the high voltage supply to the field mechanism or mechanisms supplied from the distributor box.

In an advantageous further development the lower housing compartment comprises an auxiliary switch that is mechanically coupled to the motor-protection switch. The motor-protection switch electrically disconnects the high tension leads. The auxiliary switch, because of the mechanical coupling, approximately simultaneously electrically disconnects the field-bus leads and the power-supply leads. It is advantageous here that the field mechanism or mechanisms can be completely disconnected electrically.

In an advantageous embodiment the electronic circuitry is configured so as to be addressable as a bus participant and the data destined for this address can be filtered out from the field bus and translated into a control-bus protocol, and the translated data can be sent on by way of the control bus to the one or more items of field apparatus supplied by the distributor box.

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from the braking resistance. Hence the housing simultaneously serves as a cooling device.

In another distributor box an essential characteristic is that the distributor box with at least one electronic circuit, in particular comprising microprocessor, memory and logic components and/or power semiconductor elements, with a housing, comprises

a lower housing compartment,
at least one upper housing compartment that can be connected to the lower housing compartment in a tightly sealed and stable manner, i.e. with a high degree of protection,

at least one transfer pin-and-socket connector, each of which comprises a first and a second connector part, the first connector part of which is mounted in an upper housing compartment in such a way that when this upper housing compartment is put into place on the lower housing compartment the first connector part can be brought into electrical contact with a second connector part of the transfer pin-and-socket connector, which fits together with the first part and is mounted in the lower housing compartment,

wherein in the lower housing compartment connecting devices and/or external terminal arrangements such as terminal strips or the like are mounted by which to connect a set of cables to at least the second pin-and-socket connector part in each case,

wherein the housing is in thermally conducting connection with a braking resistance of a converter.

It is advantageous here that a braking resistance can be integrated into the distributor box and the housing of the distributor box can actually be used to conduct heat away from the braking resistance. The housing thus simultaneously serves as a cooling device. Hence the braking resistance can

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be installed during manufacture, eliminating costs for installation, assembly, cabling or the like. Furthermore, there is no need to provide extra room for mounting the braking resistance.

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In another preferred embodiment the braking resistance is mounted in the interior of the housing. It is advantageous here that the housing takes over protective functions, such as shielding people from high temperatures and protection against contact in general. Furthermore, the housing can be electrically grounded and hence provides electrical protection. In another preferred embodiment the housing is made of plastic. It is advantageous here that even an insulating function can additionally be served by the housing.

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In another preferred embodiment the housing is constructed so as to give off heat, in particular comprises cooling fingers and/or cooling ribs. It is advantageous here that the housing of the distributor box can rapidly give off thermal energy into the surroundings; that is, it has a low heat-transfer resistance with respect to the surroundings.

20

In another distributor box an essential characteristic is that the distributor box with at least one electronic circuit, in particular comprising microprocessor, memory and logic components and/or power semiconductor elements, with a housing, comprises

25

a lower housing compartment,

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at least one upper housing compartment that can be connected to the lower housing compartment in a tightly sealed and stable manner, i.e. with a high degree of protection,

at least one transfer pin-and-socket connector, each of which comprises a first and a second connector part and the first connector part of which is mounted in an upper housing

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compartment in such a way that when this upper housing compartment is put into place on the lower housing compartment the first connector part can be brought into electrical contact with a second connector part of the transfer pin-and-socket connector, which fits together with the first part and is mounted in the lower housing compartment,

wherein in the lower housing compartment connecting devices and/or external terminal arrangements such as terminal strips or the like are mounted by which to connect a set of cables to at least the second pin-and-socket connector part in each case,

wherein a second upper housing compartment together with at least the lower housing compartment closes off from the surroundings or makes accessible an interior spatial region of the housing of the distributor box, so that the connecting devices and/or the external terminal arrangements are accessible for connecting the cabling.

It is advantageous here that for connecting the cabling, for example during installation, maintenance or putting the system into operation, the connecting devices and/or the external terminal arrangements are made accessible and can be altered by releasing the second upper housing compartment.

In another preferred embodiment the second upper housing compartment is the only part that must be released from the lower housing component in order to make the connecting devices and/or the external connector devices accessible in order to connect the cabling.

It is advantageous here that only one part needs to be released, for instance unscrewed. This saves time and hence also costs associated with maintenance, assembly and installation.

Preferred embodiments of the invention will be apparent from the subordinate claims.

The invention is explained in greater detail with
5 reference to the drawings.

Brief Description of the Drawings

Fig. 1 is a perspective view of a first exemplary
10 embodiment of the invention;

Fig. 2 is a perspective view of the first exemplary
embodiment of the invention with an upper housing compartment
lifted away;
15

Fig. 3 is a perspective view of a second exemplary
embodiment of the invention;

Fig. 4 is a perspective view of a cable arrangement for
20 the first exemplary embodiment with separate converter and
electric motor;

Fig. 5 is a perspective view of a third exemplary
embodiment of the invention;
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Fig. 6 is a perspective view of the third exemplary
embodiment of the invention with an upper housing compartment
lifted away.

Description of the Preferred Embodiments

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In Figure 1 an embodiment of the distributor box in
accordance with the invention is shown. It comprises a lower
housing compartment 2 and an upper housing compartment 1.
35 Field-bus cables with field-bus leads and power-supply leads
pass through the PG screw fittings 3 and apertures in the

housing wall into the interior of the lower housing compartment 2. Similarly, high tension cables pass through PG screw fittings 4 into the interior of the lower housing compartment 2. The upper housing compartment 1 is fixedly
5 attached to the lower housing compartment by means of releasable screws 5. A sealing element is inserted between the adjacent surfaces of the upper housing compartment 1 and lower housing compartment 2, so that the two compartments are joined together with a high degree of protection. The
10 electrical connection between upper housing compartment 1 and lower housing compartment 2 is accomplished by means of two pin-and-socket connector parts, which are not shown in the figure.

15 A hybrid cable coming from the field mechanism or mechanisms is led through the PG screw fitting 6 and connected to a commercially available hybrid pin-and-socket connector part 7. This is inserted into a corresponding hybrid pin-and-socket connector part as external terminal
20 arrangements of the lower housing compartment 2; the latter hybrid pin-and-socket connector part is soldered to a board 24 (see Fig. 2) in the lower housing compartment 2 and hence integrated into the lower housing compartment 2.

25 The upper housing compartment 1 comprises an electronic circuit that is electrically connected to the field-bus leads and to leads of the hybrid cable. A central computer and, in some cases, other field mechanisms are thus electrically connected by way of the field bus to the electronic circuitry
30 in the upper housing compartment 1. The electronic circuitry in the upper housing compartment 1 is provided with a field-bus address that can be set by means of DIP switches, and filters out data that are intended for this specific address. Furthermore, it translates these data into a system-bus
35 protocol and transfers the translated system-bus data by way of leads in the hybrid cable to at least one converter

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attached to the hybrid cable. Analogously, data are translated back to the field-bus protocol in the reverse order.

5 Additional converters or devices can be connected to this system bus and can also exchange data with one another. Here it is advantageous that the system bus can be designed for a very high data-transmission rate and hence is usable for special applications.

10

Figure 2 shows the same distributor box as Figure 1 but with the upper housing compartment 1 lifted away to reveal the board 24 to which the above-mentioned hybrid pin-and-socket connector is soldered. On the board 24 are mounted
15 additional external terminal arrangements 22, 25 by way of which to connect external leads such as field-bus leads, power-supply leads, high tension leads, shielding leads and neutral leads.

20 The first connector part 23 is mounted in the upper housing compartment 1 and is electrically connected to the electronic circuitry in the upper housing compartment 1. The second connector part 21 is set onto the board 24 and electrically connected thereto by soldering. The first
25 connector part 23 and the second connector part 21 thus together form a transfer pin-and-socket connector, which apart from a grounding cable constitutes the only electrical connection between upper housing compartment 1 and lower housing compartment 2.

30

In Figure 3 is shown an advantageous further development that comprises a motor-protection switch 31 for electrical disconnection of the high tension leads. This is connected to the lower housing compartment 2 and incorporates an auxiliary
35 switch for electrical disconnection of the field-bus leads with power-supply leads. That is, here the auxiliary switch

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serves for the electrical disconnection of low tension leads. Hence during installation, assembly or repair work the whole hybrid cabling with connected field equipment, such as converters with electric motors or the like, can be electrically turned off.

Figure 4 shows how a field mechanism is connected to the distributor box in accordance with the invention as shown in Figures 1 and 2. The field-bus cable is electrically looped through the lower housing compartment 2, such that the electronic circuit in the upper housing compartment 1 taps the field bus and translates the data destined for the set address into a control-bus protocol. The high tension cables 42 are likewise looped through in a T shape, such that the high tension leads in the hybrid cable 43 are connected to the high tension cables 42. The hybrid cable 43 conducts high voltage and control bus output to the converter and is looped through the converter 45. Thus additional field mechanisms, such as the converter 45 with electric motors 46 or the like, can also be connected. The converter 45 delivers power to the electric motor 46 by way of the supply cable 44.

In Figures 5 and 6 is shown another exemplary embodiment in accordance with the invention. It comprises a lower housing compartment 55, onto which several upper housing compartments 51, 52, 53 are set; these are releasably attached, by means of screws, to the lower housing compartment 55 so as to afford a high degree of protection. Figure 5 shows the upper housing compartments 51, 52, 53 thus attached, whereas Figure 6 shows the second and third upper housing compartments 52, 53 lifted away. In addition, an identification plate 59 and a motor-protection switch 54 are disposed on the lower housing compartment 55.

The lower housing compartment 55 comprises two large bores 57 for high tension leads and small bores 58 to receive

PG screw fittings for field-bus leads. The high tension leads, like the field-bus leads, are looped through in a T configuration. During assembly, therefore, one of the high tension leads is passed through one of the large bores 57 as a supply line and is attached to a terminal strip that is seated on the board 68 of the lower housing compartment 55 and is connected to the board 68 by solder joints. Conversely, in the same way a high tension cable is passed through one of the large bores 57 as an outgoing line and is attached to the terminal strip. The three-phase current is therefore conducted from the supply line through the outgoing line to other devices. By way of the board 68, however, it is also possible to redirect three-phase current to the hybrid pin-and-socket connector part 56, which thus serves as an external terminal through which to supply an electric motor that is connected there.

The first upper housing compartment 51 comprises, as in Figures 1 and 2, an electronic circuit that is electrically connected to field-bus leads and filters out from the field-bus data stream the particular data that are destined for the address set by means of DIP switches. These data are then translated into the system-bus protocol and conducted through the system bus to a converter attached thereto. In Figures 5 and 6 the converter is constructed as a third upper housing compartment 53, which contains the appropriate electronic circuit with electronic connectors, the heat of which is conducted away by the cooling device 60. The electrical connections to the lower housing compartment are provided by a pin-and-socket connector with second connector part 61. The connector devices 62 are used to connect the motor-protection switch 54. The pin-and-socket connector 63 provides a connection to the hybrid pin-and-socket connector part 56, in such a way that at least the high tension leads, leads to supply the brake of the motor (i.e., brake leads), and

temperature-sensor leads and neutral leads are sent to the hybrid connector part 56.

Again there is coupled to the motor-protection switch 54 an auxiliary switch that operates substantially simultaneously with the motor-protection switch 54. That is, it serves for the electrical disconnection of low tension leads as well as of motor-control leads.

The hybrid pin-and-socket connector part 56 shown in Figures 5 and 6 comprises, on one hand, high tension cables for large currents and voltages. On the other hand, it comprises leads that can conduct only smaller currents, i.e. low tension currents, and also voltages. Therefore it is advantageous to employ a cable with leads of various diameters, in particular when hybrid connectors are used such as, for example, the hybrid pin-and-socket connector part 56, because by this means the labor of installation can be considerably reduced.

When the second upper housing compartment 52 is lifted away, the connector devices for incoming and outgoing conduction through high tension leads are accessible, just like those for the field-bus and other leads. These connector devices are also termed external terminal arrangements, because they serve for the connection of external leads.

In the lower housing compartment 55 a braking resistance is also mounted, which is electrically connected to the connector devices 62 and hence can be connected to the electronic circuit in the third upper housing compartment 53, which is constructed as an attachable converter.

List of Reference Numerals

	1	Upper housing compartment
	2	Lower housing compartment
5	3	PG screw fitting for field bus and supply voltages
	4	PG screw fitting for high voltage
	5	Screws
	6	PG screw fitting for hybrid cables
	7	Hybrid pin-and-socket connector part
10	14	Display elements
	21	Second connector part
	22	External terminal arrangements
	23	First connector part
	24	Board
15	25	External terminal arrangements
	31	Motor-protection switch
	41	Field-bus cable
	42	High tension cable
	43	Hybrid cable
20	44	Power-supply cable
	45	Converter
	46	Electric motor
	51	First upper housing component
	52	Second upper housing component
25	53	Third upper housing component
	54	Motor-protection switch
	55	Lower housing compartment
	56	Hybrid pin-and-socket connector part
	57	Large bores
30	58	Small bores
	59	Identification plate
	60	Cooling device
	61	Second pin-and-socket connector part
	62	Connector devices
35	63	Pin-and-socket connector
	68	Board

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- 1 -

A DISTRIBUTOR BOX

The invention relates to a distributor box.

5 In industrial plants many widely scattered items of field equipment, in particular drive mechanisms, consisting of frequency or voltage converters or electrically controllable from a central unit. Various types of field buses are used, such as Profibus, CANbus or the like. The mechanism includes an addressable unit which filters data out of the field-buses which are addressed to the particular

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applied to the field equipment by way of high tension cables, in particular those designed for three-phase current.

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In many cases the manufacturers of field equipment make use of other control-bus protocols, which are not in the same category as field buses. For example, those skilled in the art will be familiar with the control-bus protocol MOVILINK, made by the firm SEW-EURODRIVE GmbH & Co. These control-bus protocols are not compatible with the field-bus protocols conventionally used in industry and are also termed system-bus protocols. They can exhibit an extremely high data-transfer rate. In particular, with such control or system buses the commands and codings are designed specifically for a certain group of devices, and in particular depend on the individual manufacturer. On the whole, with system buses the real-time performance of applications can be improved.

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The set of cables used for high voltage and bus systems is elaborate and expensive, in particular because of the

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stellate cable arrangement of the high tension wiring. One substantial cost factor is the time needed to install the cabling.

5 DE 40 05 086 discloses a terminal unit for domestic technology. The housing of this unit provides a separation between electronic circuitry and cabling. Here the cabling is mounted in the lower part of the unit and the electronic circuitry, in the upper part of the unit. This terminal unit
10 cannot be used for industrial plants.

The objective of the invention is to provide a distributor box which avoids the above-mentioned disadvantages. In particular, it is intended to enable
15 simple and inexpensive cabling.

This objective is achieved in accordance with the invention by a distributor box with the characteristics according to one of the claims 19 or 22.
20

Essential features of this solution of the problem are that the distributor box with at least one electronic circuit, in particular comprising microprocessor, memory and logic components and/or power semiconductor components, with
25 a housing, comprises

a lower housing compartment,
at least one upper housing compartment, which can be connected to the lower compartment in a tightly sealed, firm manner to provide a high degree of protection,
30 at least one transfer pin-and-socket connector, each of which comprises a first and a second connector part, the first connector part of which is fixedly mounted in an upper housing compartment in such a way that when this upper compartment is set onto the lower compartment, the first
35 connector part is brought into electrical contact with a second connector part of the transfer pin-and-socket

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connector, which fits together with the first part and is fixedly mounted in the lower housing compartment,

wherein in the lower housing compartment are mounted connecting devices or external terminal arrangements such as terminal strips or the like, so that a set of cables can be connected to at least the associated second pin-and-socket connector part,

and wherein the lower housing compartment comprises a T-shaped, high tension cabling, such as for a three-phase current, between two external connecting devices and one external terminal arrangement for a hybrid cable on the lower housing compartment,

and wherein the lower housing compartment comprises a T-shaped cabling for a field bus between two external terminal arrangements on the lower housing compartment and at least one second pin-and-socket connector part,

and wherein in at least one upper housing compartment there is mounted an electronic circuit that can be electrically connected to a control bus by way of a first and a second pin-and-socket connector part,

and wherein the lower housing compartment comprises an external means of connecting a hybrid cable with hybrid pin-and-socket connector part that incorporates high tension and low tension leads,

and wherein the high tension leads of the hybrid cable can be connected to at least one electronic circuit in an upper housing compartment.

Hence it advantageously enables the cabling arrangement to be very simple and inexpensive. In particular, parts can be preassembled and prefabricated, and thus need not be handled individually during installation in the plant. The transfer pin-and-socket connector and connector parts enable a particularly rapid, secure and simple connection of housing compartments. In particular, the use of hybrid pin-and-socket connector parts also makes it possible to close and

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disconnect high tension and low tension leads in a time-saving manner. The provision of the hybrid cable saves time and furthermore makes the layout of the whole cabling system clearer, because high tension and low tension cables no longer need to be positioned individually.

An especially crucial characteristic of the invention is that the leads of the field bus are looped through and therefore advantageously make possible annular structures of the cabling for field buses. A similar essential characteristic of the invention is that the high tension cabling is T-shaped and the branch to the associated field mechanism is enabled by a hybrid cable. Hence it is possible to use annular cabling for the high voltage as well. Here it is of advantage that such cablings can be implemented in a distinctly more economical way, with a saving of materials.

The term "field mechanism" is understood here to include an electric motor with converter, an electric motor with a simple switching device to turn it on and off, an electric motor with smooth-starting device or the like.

The term "looped through" indicates that a cable coming from the exterior is connected by leads to an external terminal arrangement in the distributor box and then, by way of internal cabling, is connected to an additional external terminal arrangement in the distributor box to which, in turn, a cable coming from the exterior is connected by leads.

The term "T-shaped cabling" should be understood to mean that a cable coming from the exterior is connected by leads to an external terminal arrangement in the distributor box and then, by way of an internal cabling, is electrically connected to at least two additional external terminal arrangements in the distributor box, to which in turn cables coming from the exterior can be connected by leads. One of

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these external terminal arrangements is designed for a hybrid cable that comprises high tension and control-bus leads.

Another particularly essential characteristic of the invention consists in the fact that cable systems and connectors are fixedly mounted in the lower housing compartment, so as to be immune to interference, whereas the electronic apparatus that requires maintenance or repair, or needs to be adjusted or replaced to suit the local conditions, is disposed in the upper housing compartment. This separation makes it possible to carry out extremely complicated maintenance work even under adverse field conditions, by merely exchanging one upper housing compartment for another one with electronics that are undamaged or suited to the altered conditions or requirements. An added benefit is that the degree of protection can be of a high standard, which is likewise facilitated in particular by the mechanical and electrical separation between the upper and lower compartments.

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Altogether, then, the distributor box comprises at least one electronic circuit, in particular one with microprocessor, memory and logic circuitry, and a housing with a lower compartment and at least one upper compartment, which can be connected thereto in a tightly sealed and stable manner and includes a transfer pin-and-socket connector, the first part of which is fixedly mounted on the upper housing compartment in such a way that when an upper housing compartment is put into place on the lower housing compartment, it is brought into electrical contact with a second connector part of the transfer pin-and-socket connector that is fixedly mounted in the lower housing compartment. In this arrangement, external terminal arrangements such as terminal strips or the like are disposed in the lower housing compartment, in order to connect a cable arrangement to the second pin-and-socket connector part, and

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in the upper housing compartment the electronic circuitry is disposed.

The low tension leads comprise, on one hand, preferably
5 braking leads to control an electric motor with brake, in
which case the braking leads can be connected to the
particular electronic circuitry that comprises a converter
and can be connected to at least control-bus leads; on the
other hand, they comprise control-bus leads, in which case
10 the control-bus leads of the hybrid cable can be connected to
the control-bus leads of the particular electronic circuitry
that is electrically connected to the field bus. It is
advantageous here that in both cases the same type of hybrid
cable can be used, so that there is a net reduction of
15 expenditure.

Preferably the transfer pin-and-socket connector
provides the only electrical connection between the cabling
in the lower housing compartment and the electronic circuitry
20 in each upper compartment. Therefore the electronics can be
repaired or exchanged by simply exchanging one upper housing
compartment for another, with minimal manipulation, as the
upper housing compartments with incorporated electronics have
been constructed or reconstructed in suitable surroundings,
25 i.e. not in the field.

In another preferable embodiment, the distributor box
comprises a ground-connection cable between each upper
housing compartment and the lower compartment. Hence the
30 transfer pin-and-socket connectors and the ground-connection
cable constitute the only electrical connection between the
upper and lower housing compartments. It is advantageous here
that the upper housing compartment is grounded even after it
has been opened or lifted off.

The field-bus leads, as low tension leads, in an advantageous embodiment also comprise leads for power supply, such as 24-V leads or the like. Shielding and grounding leads can also be included. It is advantageous here that the field-bus leads with power-supply leads are distinguished from the high tension cabling systems and can be cabled together with the field-bus leads.

In a further development the lower housing compartment comprises a motor-protection switch. It is advantageous here that for purposes of assembly, repair or installation it is possible to interrupt the high voltage supply to the field mechanism or mechanisms supplied from the distributor box.

In an advantageous further development the lower housing compartment comprises an auxiliary switch that is mechanically coupled to the motor-protection switch. The motor-protection switch electrically disconnects the high tension leads. The auxiliary switch, because of the mechanical coupling, approximately simultaneously electrically disconnects the field-bus leads and the power-supply leads. It is advantageous here that the field mechanism or mechanisms can be completely disconnected electrically.

In an advantageous embodiment the electronic circuitry is configured so as to be addressable as a bus participant and the data destined for this address can be filtered out from the field bus and translated into a control-bus protocol, and the translated data can be sent on by way of the control bus to the one or more items of field apparatus supplied by the distributor box.

In another preferred embodiment a first upper housing compartment incorporates an electronic circuit that is electrically connected at least to the field bus and the

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system bus. It is advantageous here that the electronic circuit can be designed as a bus converter and can be rapidly exchanged by means of the above-mentioned pin-and-socket connector parts. Hence it is even possible to change from one
5 bus system to another by exchanging this upper housing component, with its electronic circuit.

In another preferred embodiment the distributor box comprises a second upper housing compartment to form a
10 closed-off spatial region. It is advantageous here that by lifting up the housing compartment the space containing the external terminal arrangements becomes accessible and necessary cable installations can be carried out. Once this cabling work has been completed, the upper housing
15 compartment is replaced and hence the housing advantageously again becomes tightly sealed and firmly reconnected, i.e. is closed with a high degree of protection.

In yet another preferred embodiment the distributor box
20 comprises a third upper housing compartment with an electronic circuit that can be connected electrically to at least the system bus and brake leads. It is advantageous here that the electronic circuit can be designed as a converter and hence the distributor box can supply, control and
25 regulate an electric motor.

In another preferred embodiment the lower housing compartment comprises a braking resistance of a converter and the braking resistance is electrically connected to the
30 electronic circuit of the third upper housing compartment. It is advantageous here that a braking resistance can be integrated into the distributor box and the housing of the distributor box can actually be used to conduct heat away from the braking resistance. Hence the housing simultaneously
35 serves as a cooling device.

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In another distributor box an essential characteristic is that the distributor box with at least one electronic circuit, in particular comprising microprocessor, memory and logic components and/or power semiconductor elements, with a
5 housing, comprises

a lower housing compartment,
at least one upper housing compartment that can be connected to the lower housing compartment in a tightly sealed and stable manner, i.e. with a high degree of
10 protection,

at least one transfer pin-and-socket connector, each of which comprises a first and a second connector part, the first connector part of which is mounted in an upper housing compartment in such a way that when this upper housing
15 compartment is put into place on the lower housing compartment the first connector part can be brought into electrical contact with a second connector part of the transfer pin-and-socket connector, which fits together with the first part and is mounted in the lower housing
20 compartment,

wherein in the lower housing compartment connecting devices and/or external terminal arrangements such as terminal strips or the like are mounted by which to connect a set of cables to at least the second pin-and-socket connector
25 part in each case,

wherein the housing is in thermally conducting connection with a braking resistance of a converter.

It is advantageous here that a braking resistance can be
30 integrated into the distributor box and the housing of the distributor box can actually be used to conduct heat away from the braking resistance. The housing thus simultaneously serves as a cooling device. Hence the braking resistance can be installed during manufacture, eliminating costs for
35 installation, assembly, cabling or the like. Furthermore,

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there is no need to provide extra room for mounting the braking resistance.

5 In another preferred embodiment the braking resistance is mounted in the interior of the housing. It is advantageous here that the housing takes over protective functions, such as shielding people from high temperatures and protection against contact in general. Furthermore, the housing can be electrically grounded and hence provides electrical protection. In another preferred embodiment the housing is made of plastic. It is advantageous here that even an insulating function can additionally be served by the housing.

15 In another preferred embodiment the housing is constructed so as to give off heat, in particular comprises cooling fingers and/or cooling ribs. It is advantageous here that the housing of the distributor box can rapidly give off thermal energy into the surroundings; that is, it has a low heat-transfer resistance with respect to the surroundings.

25 In another distributor box an essential characteristic is that the distributor box with at least one electronic circuit, in particular comprising microprocessor, memory and logic components and/or power semiconductor elements, with a housing, comprises

a lower housing compartment,
at least one upper housing compartment that can be connected to the lower housing compartment in a tightly sealed and stable manner, i.e. with a high degree of protection,

at least one transfer pin-and-socket connector, each of which comprises a first and a second connector part and the first connector part of which is mounted in an upper housing compartment in such a way that when this upper housing compartment is put into place on the lower housing

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List of reference numerals

	1	Upper housing compartment
	2	Lower housing compartment
5	3	PG screw fitting for field bus and supply voltages
	4	PG screw fitting for high voltage
	5	Screws
	6	PG screw fitting for hybrid cables
	7	Hybrid pin-and-socket connector part
10	14	Display elements
	21	Second connector part
	22	External terminal arrangements
	23	First connector part
	24	Board
15	25	External terminal arrangements
	31	Motor-protection switch
	41	Field-bus cable
	42	High tension cable
	43	Hybrid cable
20	44	Power-supply cable
	45	Converter
	46	Electric motor
	51	First upper housing component
	52	Second upper housing component
25	53	Third upper housing component
	54	Motor-protection switch
	55	Lower housing compartment
	56	Hybrid pin-and-socket connector part
	57	Large bores
30	58	Small bores
	59	Identification plate
	60	Cooling device
	61	Second pin-and-socket connector part
	62	Connector devices
35	63	Pin-and-socket connector
	68	Board

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The invention is explained in greater detail with reference to drawings, wherein

Fig. 1 is a perspective view of a first exemplary
5 embodiment of the invention;

Fig. 2 is a perspective view of the first exemplary embodiment of the invention with an upper housing compartment lifted away;

Fig. 3 is a perspective view of a second exemplary embodiment of the invention;

Fig. 4 is a perspective view of a cable arrangement for
15 the first exemplary embodiment with separate converter and
electric motor;

Fig. 5 is a perspective view of a third exemplary embodiment of the invention;

Fig. 6 is a perspective view of the third exemplary embodiment of the invention with an upper housing compartment lifted away.

25 In Figure 1 an embodiment of the distributor box in accordance with the invention is shown. It comprises a lower housing compartment 2 and an upper housing compartment 1. Field-bus cables with field-bus leads and power-supply leads pass through the PG screw fittings 3 and apertures in the housing wall into the interior of the lower housing compartment 2. Similarly, high tension cables pass through PG screw fittings 4 into the interior of the lower housing compartment 2. The upper housing compartment 1 is fixedly attached to the lower housing compartment by means of releasable screws 5. A sealing element is inserted between the adjacent surfaces of the upper housing compartment 1 and

lower housing compartment 2, so that the two compartments are joined together with a high degree of protection. The electrical connection between upper housing compartment 1 and lower housing compartment 2 is accomplished by means of two pin-and-socket connector parts, which are not shown in the figure.

A hybrid cable coming from the field mechanism or mechanisms is led through the PG screw fitting 6 and connected to a commercially available hybrid pin-and-socket connector part 7. This is inserted into a corresponding hybrid pin-and-socket connector part as external terminal arrangements of the lower housing compartment 2; the latter hybrid pin-and-socket connector part is soldered to a board 24 (see Fig. 2) in the lower housing compartment 2 and hence integrated into the lower housing compartment 2.

The upper housing compartment 1 comprises an electronic circuit that is electrically connected to the field-bus leads and to leads of the hybrid cable. A central computer and, in some cases, other field mechanisms are thus electrically connected by way of the field bus to the electronic circuitry in the upper housing compartment 1. The electronic circuitry in the upper housing compartment 1 is provided with a field-bus address that can be set by means of DIP switches, and filters out data that are intended for this specific address. Furthermore, it translates these data into a system-bus protocol and transfers the translated system-bus data by way of leads in the hybrid cable to at least one converter attached to the hybrid cable. Analogously, data are translated back to the field-bus protocol in the reverse order.

Additional converters or devices can be connected to this system bus and can also exchange data with one another. Here it is advantageous that the system bus can be designed

for a very high data-transmission rate and hence is usable for special applications.

Figure 2 shows the same distributor box as Figure 1 but with the upper housing compartment 1 lifted away to reveal the board 24 to which the above-mentioned hybrid pin-and-socket connector is soldered. On the board 24 are mounted additional external terminal arrangements 22, 25 by way of which to connect external leads such as field-bus leads, power-supply leads, high tension leads, shielding leads and neutral leads.

The first connector part 23 is mounted in the upper housing compartment 1 and is electrically connected to the electronic circuitry in the upper housing compartment 1. The second connector part 21 is set onto the board 24 and electrically connected thereto by soldering. The first connector part 23 and the second connector part 21 thus together form a transfer pin-and-socket connector, which apart from a grounding cable constitutes the only electrical connection between upper housing compartment 1 and lower housing compartment 2.

In Figure 3 is shown an advantageous further development that comprises a motor-protection switch 31 for electrical disconnection of the high tension leads. This is connected to the lower housing compartment 2 and incorporates an auxiliary switch for electrical disconnection of the field-bus leads with power-supply leads. That is, here the auxiliary switch serves for the electrical disconnection of low tension leads. Hence during installation, assembly or repair work the whole hybrid cabling with connected field equipment, such as converters with electric motors or the like, can be electrically turned off.

Figure 4 shows how a field mechanism is connected to the distributor box in accordance with the invention as shown in Figures 1 and 2. The field-bus cable is electrically looped through the lower housing compartment 2, such that the electronic circuit in the upper housing compartment 1 taps the field bus and translates the data destined for the set address into a control-bus protocol. The high tension cables 42 are likewise looped through in a T shape, such that the high tension leads in the hybrid cable 43 are connected to the high tension cables 42. The hybrid cable 43 conducts high voltage and control bus output to the converter and is looped through the converter 45. Thus additional field mechanisms, such as the converter 45 with electric motors 46 or the like, can also be connected. The converter 45 delivers power to the electric motor 46 by way of the supply cable 44.

In Figures 5 and 6 is shown another exemplary embodiment in accordance with the invention. It comprises a lower housing compartment 55, onto which several upper housing compartments 51, 52, 53 are set; these are releasably attached, by means of screws, to the lower housing compartment 55 so as to afford a high degree of protection. Figure 5 shows the upper housing compartments 51, 52, 53 thus attached, whereas Figure 6 shows the second and third upper housing compartments 52, 53 lifted away. In addition, an identification plate 59 and a motor-protection switch 54 are disposed on the lower housing compartment 55.

The lower housing compartment 55 comprises two large bores 57 for high tension leads and small bores 58 to receive PG screw fittings for field-bus leads. The high tension leads, like the field-bus leads, are looped through in a T configuration. During assembly, therefore, one of the high tension leads is passed through one of the large bores 57 as a supply line and is attached to a terminal strip that is seated on the board 68 of the lower housing compartment 55

and is connected to the board 68 by solder joints. Conversely, in the same way a high tension cable is passed through one of the large bores 57 as an outgoing line and is attached to the terminal strip. The three-phase current is therefore conducted from the supply line through the outgoing line to other devices. By way of the board 68, however, it is also possible to redirect three-phase current to the hybrid pin-and-socket connector part 56, which thus serves as an external terminal through which to supply an electric motor that is connected there.

The first upper housing compartment 51 comprises, as in Figures 1 and 2, an electronic circuit that is electrically connected to field-bus leads and filters out from the field-bus data stream the particular data that are destined for the address set by means of DIP switches. These data are then translated into the system-bus protocol and conducted through the system bus to a converter attached thereto. In Figures 5 and 6 the converter is constructed as a third upper housing compartment 53, which contains the appropriate electronic circuit with electronic connectors, the heat of which is conducted away by the cooling device 60. The electrical connections to the lower housing compartment are provided by a pin-and-socket connector with second connector part 61. The connector devices 62 are used to connect the motor-protection switch 54. The pin-and-socket connector 63 provides a connection to the hybrid pin-and-socket connector part 56, in such a way that at least the high tension leads, leads to supply the brake of the motor (i.e., brake leads), and temperature-sensor leads and neutral leads are sent to the hybrid connector part 56.

Again there is coupled to the motor-protection switch 54 an auxiliary switch that operates substantially simultaneously with the motor-protection switch 54. That is,

it serves for the electrical disconnection of low tension leads as well as of motor-control leads.

5 The hybrid pin-and-socket connector part 56 shown in
Figures 5 and 6 comprises, on one hand, high tension cables
for large currents and voltages. On the other hand, it
comprises leads that can conduct only smaller currents, i.e.
low tension currents, and also voltages. Therefore it is
advantageous to employ a cable with leads of various
10 diameters, in particular when hybrid connectors are used such
as, for example, the hybrid pin-and-socket connector part 56,
because by this means the labor of installation can be
considerably reduced.

15 When the second upper housing compartment 52 is lifted
away, the connector devices for incoming and outgoing
conduction through high tension leads are accessible, just
like those for the field-bus and other leads. These connector
devices are also termed external terminal arrangements,
20 because they serve for the connection of external leads.

In the lower housing compartment 55 a braking resistance
is also mounted, which is electrically connected to the
connector devices 62 and hence can be connected to the
25 electronic circuit in the third upper housing compartment 53,
which is constructed as an attachable converter.

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CLAIMS

1. Distributor box with at least one electronic circuit, in particular comprising microprocessor, memory and logic components and/or power semiconductor components, with a housing, comprising
- a lower housing compartment (2),
- at least one upper housing compartment (1, 51, 52, 53), which can be connected to the lower compartment (2, 55) in a tightly sealed, stable manner to provide a high degree of protection,
- at least one transfer pin-and-socket connector, each of which comprises a first and a second connector part (21, 23, 61), the **first** connector part (23) of which is fixedly mounted in an **upper** housing compartment (1, 51, 52, 53) in such a way that when this upper compartment (1, 51, 52, 53) is set onto the lower compartment (2), the first connector part is brought into electrical contact with a **second** connector part (21, 61) of the transfer pin-and-socket connector, which fits together with the first part and is fixedly mounted in the **lower** housing compartment (2),
- wherein in the lower housing compartment (2) are mounted connecting devices or external terminal arrangements (22, 25) such as terminal strips or the like, so that a set of cables can be connected to at least the associated second pin-and-socket connector part (21, 61),
- and wherein the lower housing compartment (2) comprises a T-shaped, high tension cabling, such as for three-phase current, between two external terminal

arrangements and one external terminal arrangement for a hybrid cable (43) on the lower housing compartment (2),

and wherein the lower housing compartment (2) comprises a T-shaped cabling for a field bus between two external connecting devices on the lower housing compartment (2) and at least one second pin-and-socket connector part,

and wherein in at least one upper housing compartment (1, 51, 52, 53) there is mounted an electronic circuit that can be electrically connected to a control bus by way of a first and a second pin-and-socket connector part,

and wherein the lower housing compartment (2) comprises a hybrid pin-and-socket connector part (56) as an external means of connecting a hybrid cable with hybrid pin-and-socket connector part, which incorporates high tension and low tension leads,

and wherein the high tension leads of the hybrid cable (43) can be connected to at least one electronic circuit in an upper housing compartment (1, 51, 52, 53).

2. Distributor box according to Claim 1, **characterized in that** the low tension leads comprise brake leads to drive an electric motor (46) with brake and the brake leads can be connected to the electronic circuit that comprises a converter (45) and can be connected at least to control-bus leads.

3. Distributor box according to Claim 1, **characterized in that** the low tension leads are control-bus leads and the control-bus leads in the hybrid cable (43) can be connected to the control-bus leads of the

electronic circuit that is electrically connected to the field bus.

4. Distributor box according to one of the preceding claims,
characterized in that a first upper housing compartment (51) comprises an electronic circuit that is electrically connected at least to the field bus and the system bus.
5. Distributor box according to one of the preceding claims,
characterized in that a second upper housing compartment (52) defines a closed spatial region.
6. Distributor box according to one of the preceding claims,
characterized in that a third upper housing compartment (53) comprises an electronic circuit that can be electrically connected to at least the system bus and brake leads.
7. Distributor box according to one of the preceding claims,
characterized in that the lower housing compartment (2) comprises a braking resistance of a converter (45) and the braking resistance is connected to the electronic circuit of the third upper housing compartment (53).
8. Distributor box according to one of the preceding claims,
characterized in that the transfer pin-and-socket connector in each case constitutes the only electrical connection between the cabling in the lower housing compartment (2) and the electronic circuit in the associated upper housing compartment (1, 51, 52, 53).

9. Distributor box according to one of the claims 1 to 7,
characterized in that the transfer pin-and-socket
connector device in each case and a ground-connection
cable constitute the only electrical connection between
the cabling in the lower housing compartment (2) and the
electronic circuit in the associated upper housing
compartment (1, 51, 52, 53).
10. Distributor box according to one of the preceding
claims,
characterized in that the set of field-bus leads and/or
control-bus leads also includes leads for supply
voltages.
11. Distributor box according to one of the preceding
claims,
characterized in that the lower housing compartment (2)
comprises a motor-protection switch (31, 54), in
particular for the electrical disconnection of high
tension leads.
12. Distributor box according to Claim 11,
characterized in that the lower housing compartment (2)
comprises an auxiliary switch, in particular for the
electrical disconnection of motor-control leads and/or
low tension leads, which is mechanically coupled to the
motor-protection switch.
13. Distributor box according to one of the preceding
claims,
characterized in that the electronic circuit is designed
so as to be addressable as a bus participant and can
filter out from the field bus data that are destined for
this address and translate them into a control-bus
protocol and send the result by way of the control bus

to the field mechanism or mechanisms supplied from the distributor box.

5 14. Distributor box according to one of the preceding claims,
characterized in that the electronic circuit comprises settable switches, such as DIP switches or the like, with which to set the field-bus address.

10 15. Distributor box according to one of the preceding claims,
characterized in that at least one upper housing compartment (1, 51, 52, 53) comprises connector devices for the connection of external sensors and/or actuators.

15 16. Distributor box according to one of the preceding claims,
characterized in that at least one upper housing compartment (1, 51, 52, 53) comprises a connector device
20 for a control unit, in particular a computing device such as a PC or the like, in particular for balancing SPS programs, control programs, data or the like and/or devices for outputting and/or displaying data such as the states of sensors, actuators or drive mechanisms.

25 17. Distributor box according to one of the preceding claims,
characterized in that at least one upper housing compartment (1, 51, 52, 53) comprises display devices
30 such as LEDs and/or LCD displays or the like.

18. Distributor box according to one of the preceding claims,
characterized in that at least one upper housing
35 compartment (1, 51, 52, 53) comprises control elements

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such as keys, push-buttons, rotating knobs or the like for input and/or for controlling processes.

19. Distributor box with at least one electronic circuit, in particular comprising microprocessor, memory and logic components and/or power semiconductor components, with a housing, comprising
- a lower housing compartment (2),
- at least one upper housing compartment (1, 51, 52, 53), which can be connected to the lower compartment (2) in a tightly sealed, stable manner to provide a high degree of protection,
- at least one transfer pin-and-socket connector, each of which comprises a first and a second connector part (21, 23, 61), the **first** connector part (23, 61) of which is fixedly mounted in an upper housing compartment (1, 51, 52, 53) in such a way that when this upper compartment (1, 51, 52, 53) is set onto the lower compartment (2), the first connector part is brought into electrical contact with a **second** connector part (21, 61) of the transfer pin-and-socket connector, which fits together with the first part and is fixedly mounted in the **lower** housing compartment (2),
- wherein in the lower housing compartment (2) are mounted connecting devices or external terminal arrangements (22, 25) such as terminal strips or the like, so that a set of cables can be connected to at least the associated second pin-and-socket connector part (21, 61),
- wherein in the housing a braking resistance of a

converter (45) is mounted in thermally conducting connection to the housing.

20. Distributor box according to Claim 19,
5 **characterized in that** the braking resistance is mounted in the interior of the housing.
21. Distributor box according to at least one of the claims 19 to 20,
10 **characterized in that** the housing is constructed at least in part for giving off heat, in particular comprises cooling fingers and/or cooling ribs (60).
22. Distributor box with at least one electronic circuit, in
15 particular comprising microprocessor, memory and logic components and/or power semiconductor components, with a housing, comprising
- 20 a lower housing compartment (2),
- at least one upper housing compartment (1, 51, 52, 53), which can be connected to the lower compartment (2) in a tightly sealed, stable manner to provide a high degree of protection,
- 25 at least one transfer pin-and-socket device, each of which comprises a first and a second connector part (21, 61), the **first** connector part of which is mounted in an upper housing compartment (1, 51, 52, 53) in such a way
30 that when this upper compartment (1, 51, 52, 53) is set onto the lower compartment (2), the first connector part is brought into electrical contact with a **second** connector part (21, 61) of the transfer pin-and-socket device, which fits together with the first part and is
35 fixedly mounted in the lower housing compartment (2),

wherein in the lower housing compartment (2) are mounted connecting devices or external terminal devices (22, 25) such as terminal strips or the like, so that a set of cables can be connected to at least the associated second pin-and-socket connector part (21, 61),

wherein a second upper housing compartment (52) together with at least the lower housing compartment (2) closes off from the surroundings or makes accessible an interior spatial region of the housing of the distributor box so that the connecting devices and/or the external terminal arrangements are accessible for connection of the cabling.

23. Distributor box according to Claim 22, characterized in that the second upper housing compartment (52) is the only part that must be released from the lower housing compartment (2) in order to make the connecting devices and/or the external terminal arrangements accessible for connection of the cabling.

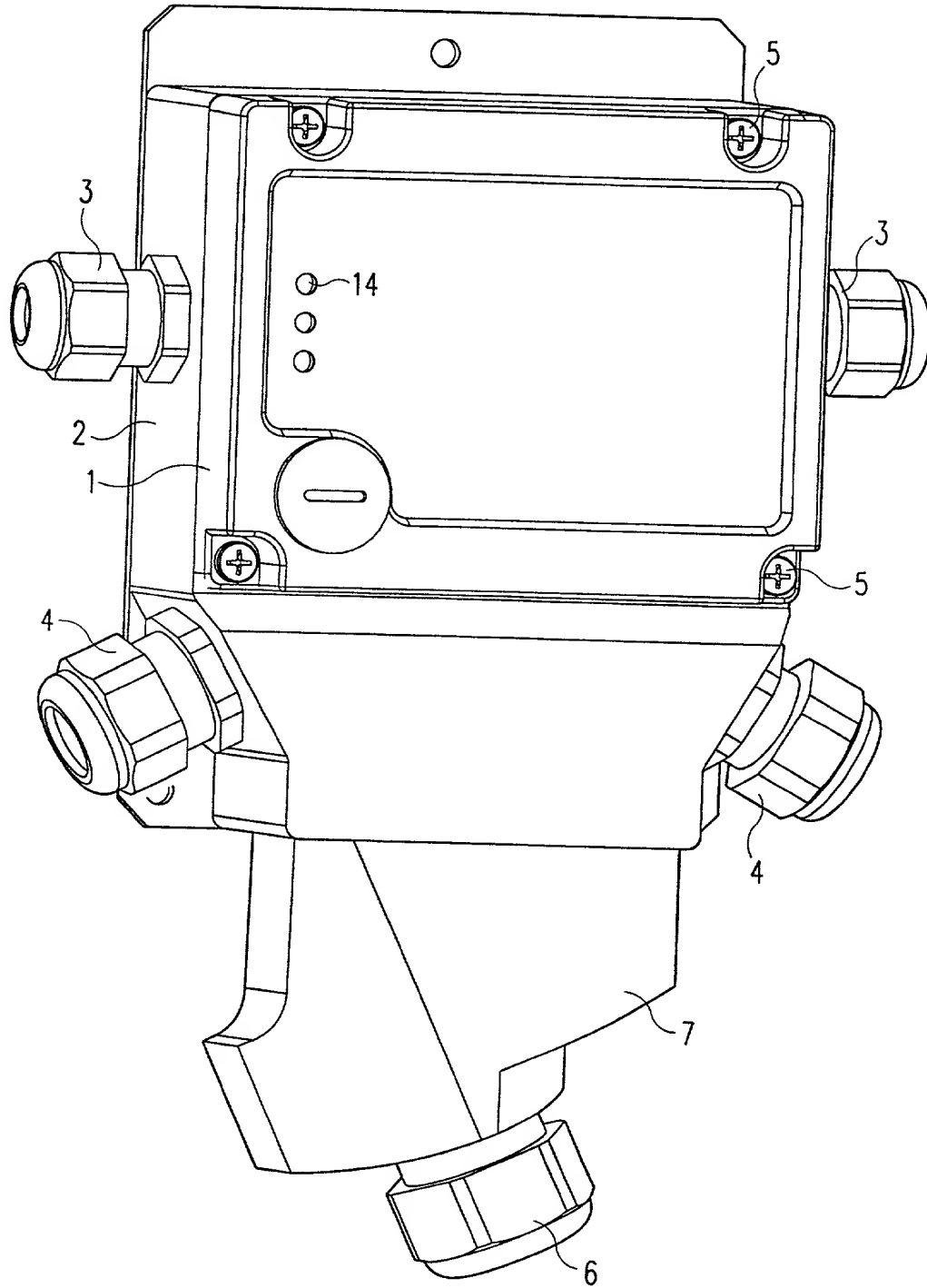


Fig. 1

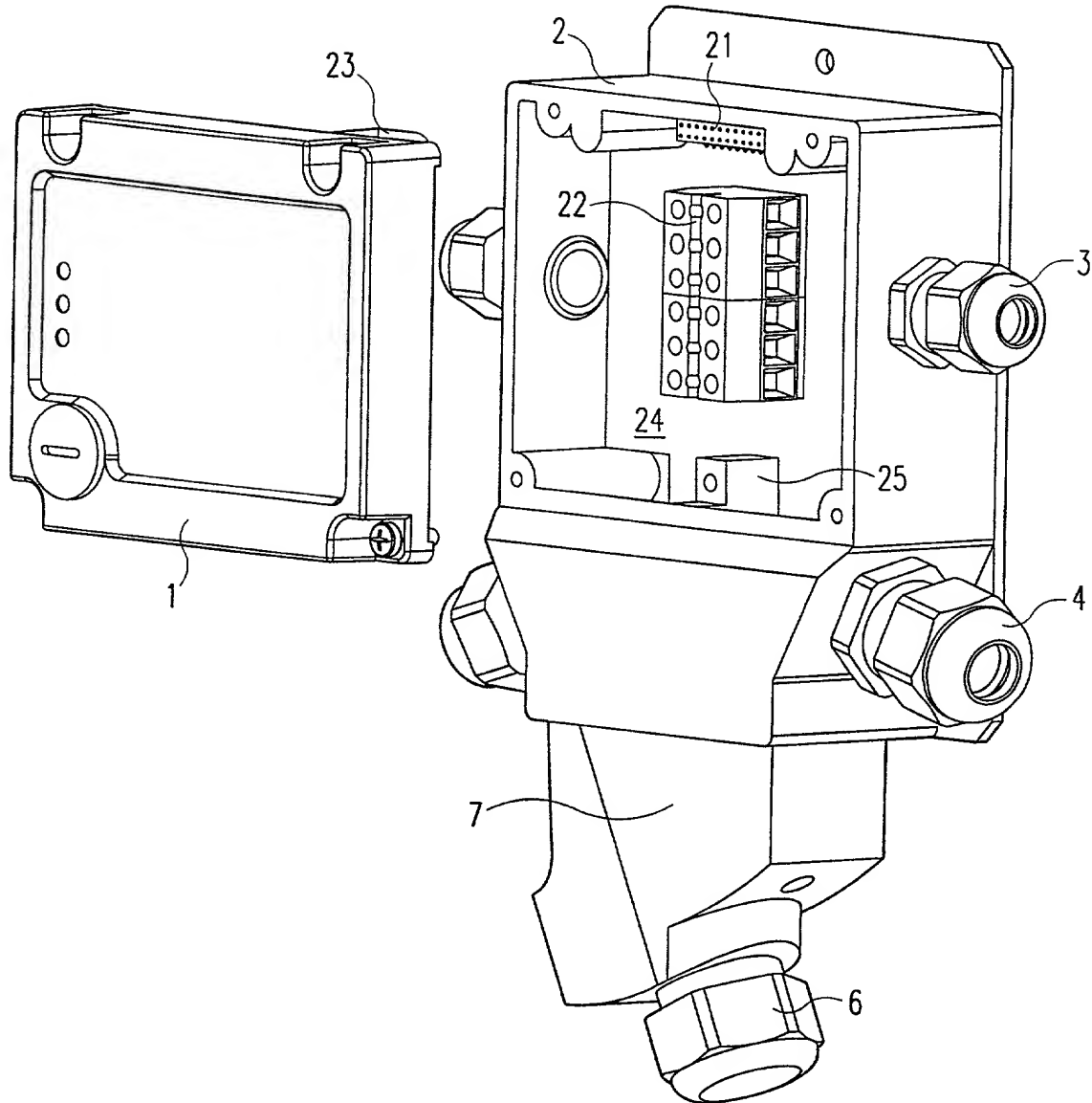


Fig. 2

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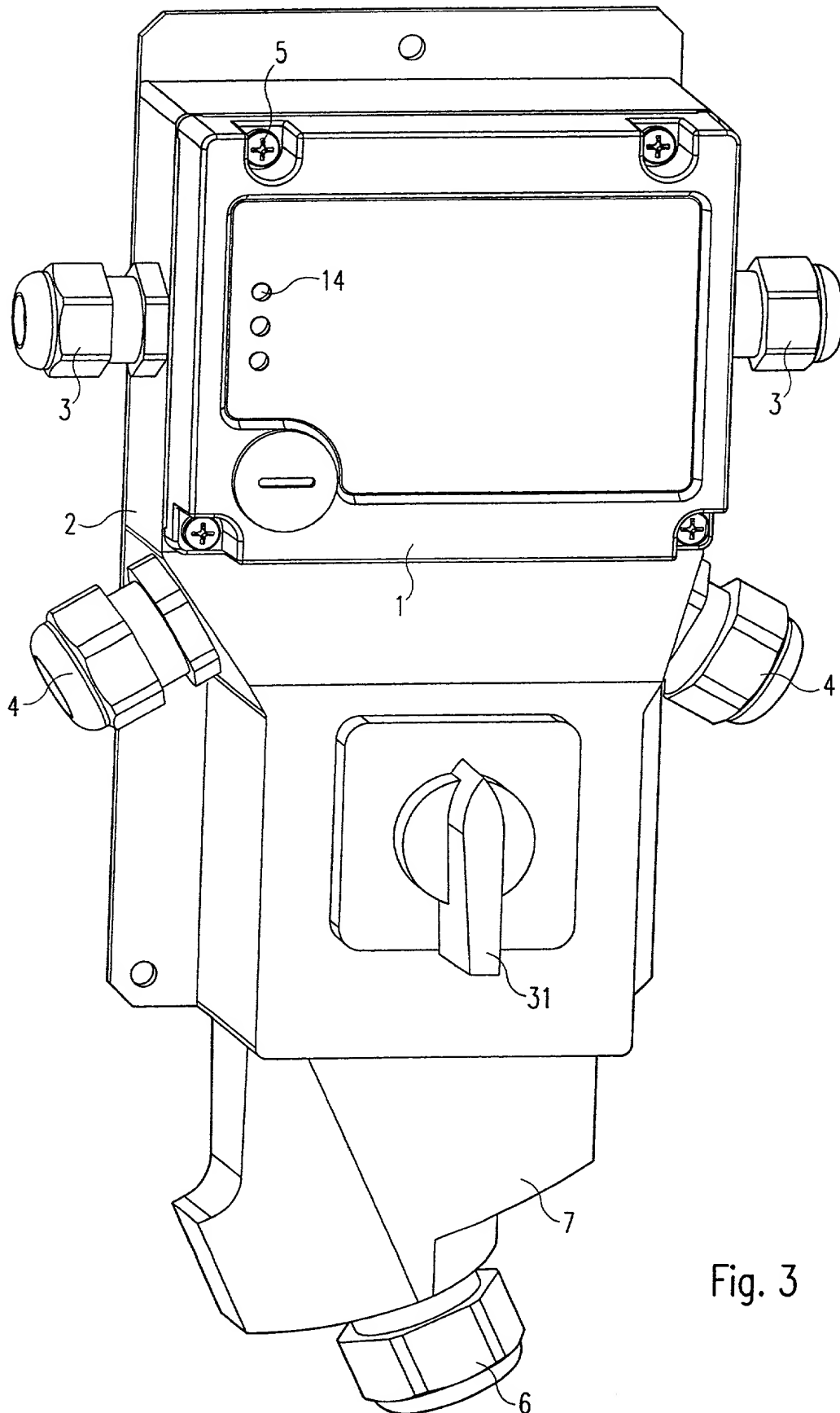


Fig. 3

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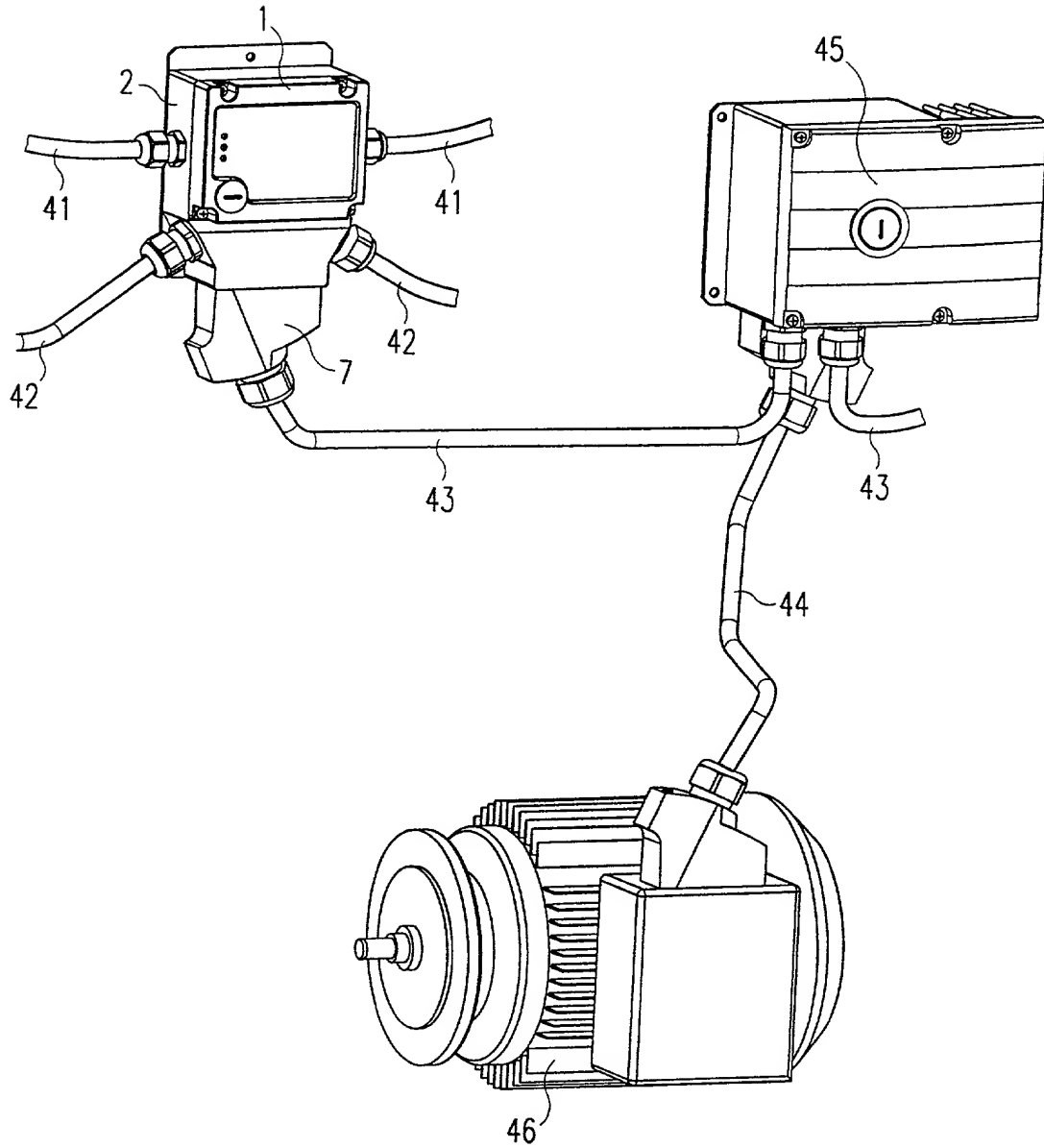


Fig. 4

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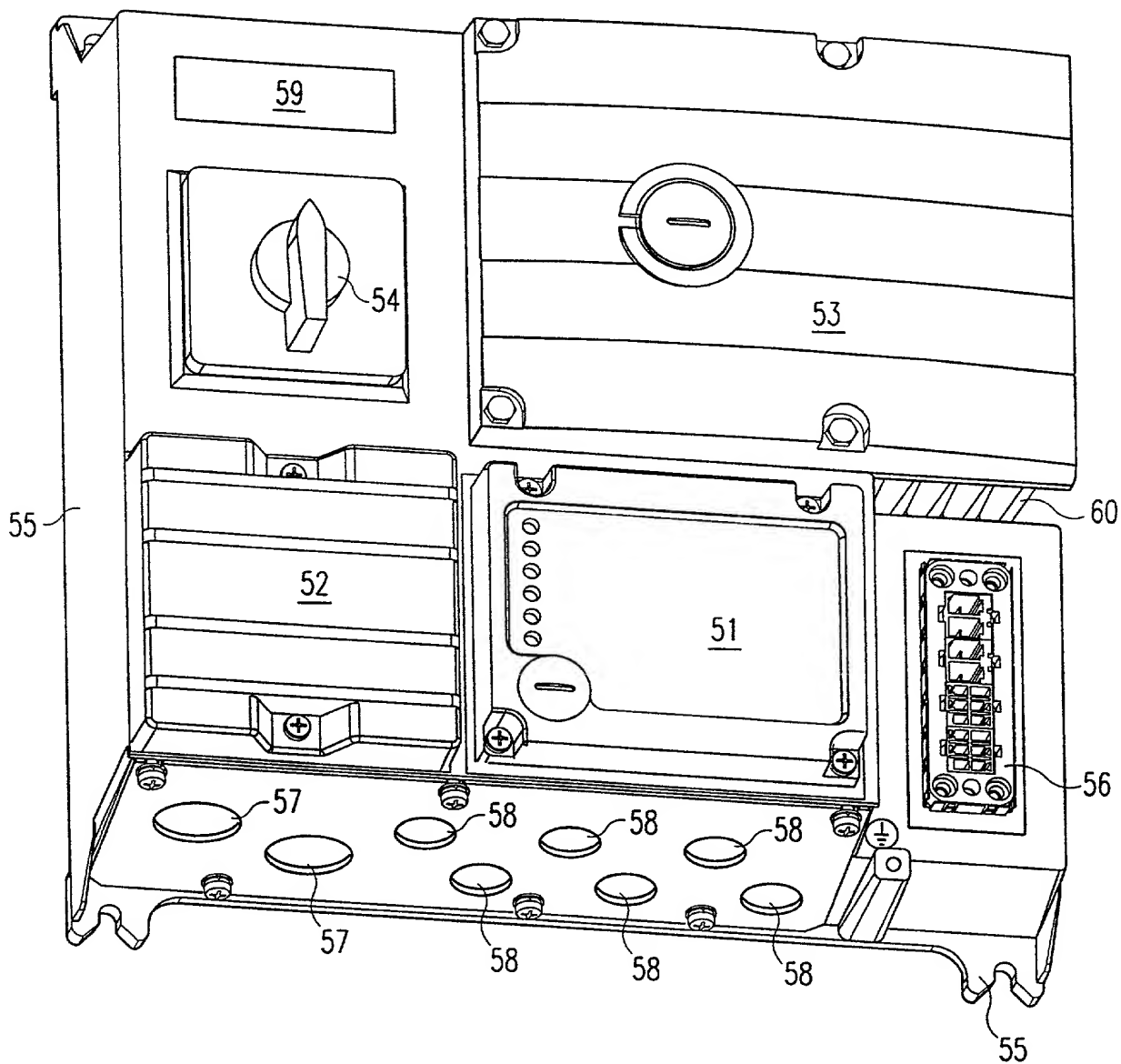
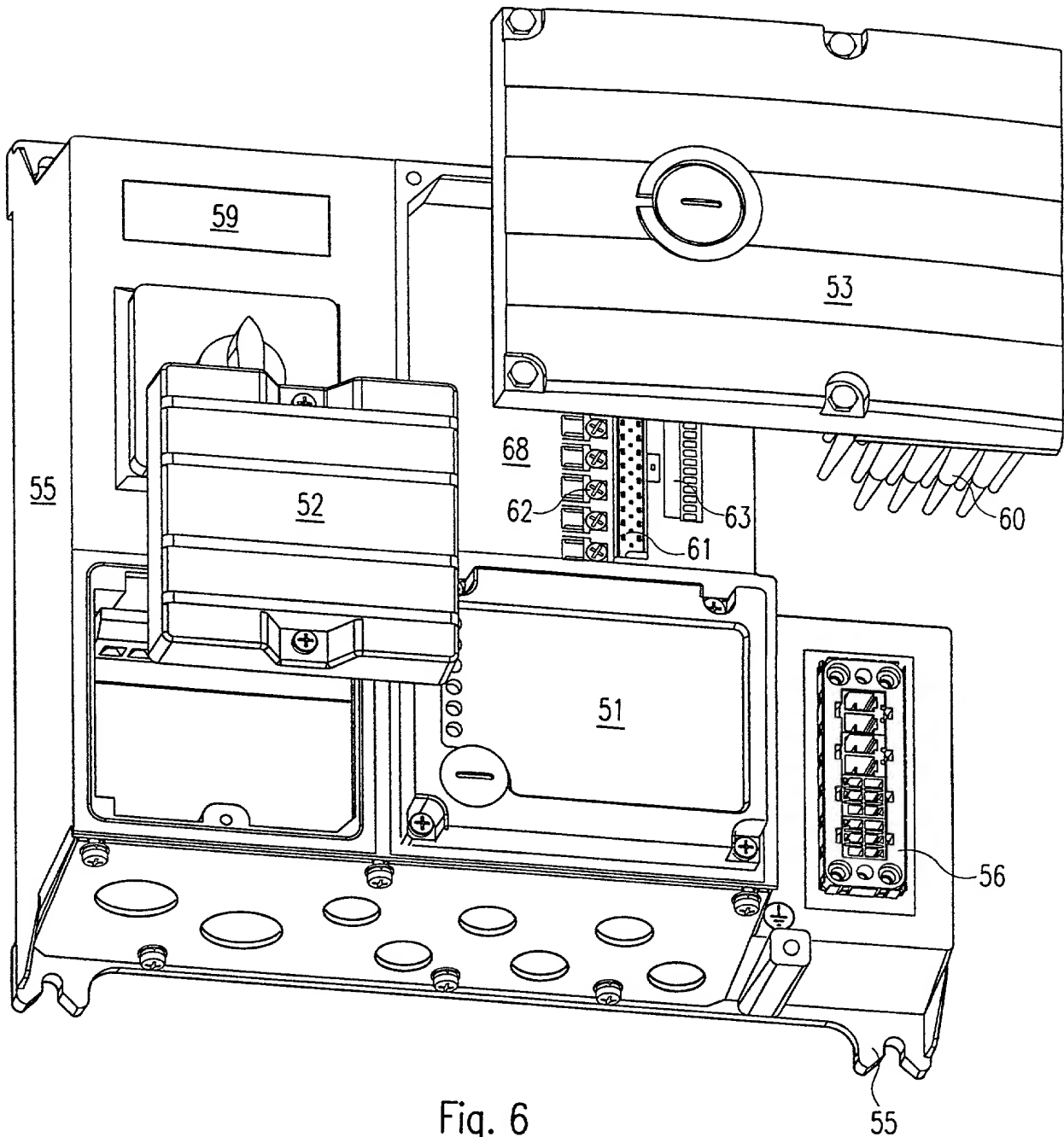


Fig. 5

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MERCHANT & GOULD P.C.

United States Patent Application

COMBINED DECLARATION AND POWER OF ATTORNEY

As a below named inventor I hereby declare that: my residence, post office address and citizenship are as stated below next to my name; that

I verily believe I am the original, first and sole inventor (if only one name is listed below) or a joint inventor (if plural inventors are named below) of the subject matter which is claimed and for which a patent is sought on the invention entitled: DISTRIBUTION BOX

The specification of which

- a. ☐ is attached hereto
 b. ☒ was filed on _____ as application serial no. _____ and was amended on _____ (if applicable) (in the case of a PCT-filed application) described and claimed in international no. PCT/EP00/01034 filed 9 February 2000 and as amended on _____ (if any), which I have reviewed and for which I solicit a United States patent.

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I hereby claim foreign priority benefits under Title 35, United States Code, § 119/365 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on the basis of which priority is claimed:

- a. ☐ no such applications have been filed.
 b. ☒ such applications have been filed as follows:

FOREIGN APPLICATION(S), IF ANY, CLAIMING PRIORITY UNDER 35 USC § 119			
COUNTRY	APPLICATION NUMBER	DATE OF FILING (day, month, year)	DATE OF ISSUE (day, month, year)
Germany	199 05 952.7	12 February 1999	
ALL FOREIGN APPLICATION(S), IF ANY, FILED BEFORE THE PRIORITY APPLICATION(S)			
COUNTRY	APPLICATION NUMBER	DATE OF FILING (day, month, year)	DATE OF ISSUE (day, month, year)

I hereby claim the benefit under Title 35, United States Code, § 120/365 of any United States and PCT international application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, § 112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, § 1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application.

U.S. APPLICATION NUMBER	DATE OF FILING (day, month, year)	STATUS (patented, pending, abandoned)

I hereby claim the benefit under Title 35, United States Code § 119(e) of any United States provisional application(s) listed below:

U.S. PROVISIONAL APPLICATION NUMBER	DATE OF FILING (Day, Month, Year)

Acknowledge the duty to disclose information that is material to the patentability of this application in accordance with Title 37, Code of Federal Regulations, § 1.56 (reprinted below):

§ 1.56 Duty to disclose information material to patentability.

(a) A patent by its very nature is affected with a public interest. The public interest is best served, and the most effective patent examination occurs when, at the time an application is being examined, the Office is aware of and evaluates the teachings of all information material to patentability. Each individual associated with the filing and prosecution of a patent application has a duty of candor and good faith in dealing with the Office, which includes a duty to disclose to the Office all information known to that individual to be material to patentability as defined in this section. The duty to disclose information exists with respect to each pending claim until the claim is canceled or withdrawn from consideration, or the application becomes abandoned. Information material to the patentability of a claim that is canceled or withdrawn from consideration need not be submitted if the information is not material to the patentability of any claim remaining under consideration in the application. There is no duty to submit information which is not material to the patentability of any existing claim. The duty to disclose all information known to be material to patentability is deemed to be satisfied if all information known to be material to patentability of any claim issued in a patent was cited by the Office or submitted to the Office in the manner prescribed by §§ 1.97(b)-(d) and 1.98. However, no patent will be granted on an application in connection with which fraud on the Office was practiced or attempted or the duty of disclosure was violated through bad faith or intentional misconduct. The Office encourages applicants to carefully examine:

(1) prior art cited in search reports of a foreign patent office in a counterpart application, and

(2) the closest information over which individuals associated with the filing or prosecution of a patent application believe any pending claim patentably defines, to make sure that any material information contained therein is disclosed to the Office.

(b) Under this section, information is material to patentability when it is not cumulative to information already of record or being made of record in the application, and

(1) It establishes, by itself or in combination with other information, a prima facie case of unpatentability of a claim;

(2) It refutes, or is inconsistent with, a position the applicant takes in:

(i) Opposing an argument of unpatentability relied on by the Office, or

(ii) Asserting an argument of patentability.

A prima facie case of unpatentability is established when the information compels a conclusion that a claim is unpatentable under the preponderance of evidence, burden-of-proof standard, giving each term in the claim its broadest reasonable construction consistent with the specification, and before any consideration is given to evidence which may be submitted in an attempt to establish a contrary conclusion of patentability.

(c) Individuals associated with the filing or prosecution of a patent application within the meaning of this section are:

(1) Each inventor named in the application;

(2) Each attorney or agent who prepares or prosecutes the application; and

(3) Every other person who is substantively involved in the preparation or prosecution of the application and who is associated with the inventor, with the assignee or with anyone to whom there is an obligation to assign the application.

(d) Individuals other than the attorney, agent or inventor may comply with this section by disclosing information to the attorney, agent, or inventor.

(e) In any continuation-in-part application, the duty under this section includes the duty to disclose to the Office all information known to the person to be material to patentability, as defined in paragraph (b) of this section, which became available between the filing date of the prior application and the national or PCT international filing date of the continuation-in-part application.

I hereby appoint the following attorney(s) and/or patent agent(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected herewith:

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I hereby authorize them to act and rely on instructions from and communicate directly with the person/assignee/attorney/firm/ organization who/which first sends/sent this case to them and by whom/which I hereby declare that I have consented after full disclosure to be represented unless/until I instruct Merchant & Gould P.C. to the contrary.

I understand that the execution of this document, and the grant of a power of attorney, does not in itself establish an attorney-client relationship between the undersigned and the law firm Merchant & Gould P.C., or any of its attorneys.

Please direct all correspondence in this case to Merchant & Gould P.C. at the address indicated below:

Merchant & Gould P.C.
 P.O. Box 2903
 Minneapolis, MN 55402-0903



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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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